West Sussex County Council

A29 REALIGNMENT PHASE 1

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7 NOISE AND VIBRATION

7.1 INTRODUCTION

7.1.1. This chapter reports the outcome of the assessment of likely significant effects arising from the Scheme upon noise and vibration.

7.1.2. This chapter describes the assessment methodology and the baseline conditions relevant to the assessment, which have been used to reach these conclusions, as well as a summary of the likely significant effects leading to the secondary mitigation measures required to avoid, prevent, reduce or, if possible, offset any likely significant adverse effects, and the likely residual effects and any required monitoring after these measures have been employed.

7.1.3. This chapter (and its associated figures and appendices) is intended to be read as part of the wider ES, with particular reference to **Chapter 10: Landscape and Visual**.

7.2 LEGISLATIVE FRAMEWORK, POLICY AND GUIDANCE

LEGISLATIVE FRAMEWORK

7.2.1. The applicable legislative framework is summarised in **Table 7-1** below.

Table 7-1 - Noise and Vibration: Summary of Legislation

Legislation	Summary
Control of Pollution Act 1974 (Ref. 7.1)	Part III of Control of Pollution Act (CoPA) 1974 gives local authorities powers to control construction site noise and vibration. Best Practicable Means (BPM) is defined in Section 72 of CoPA (Ref 7.1). In this definition 'practicable' means reasonably practicable having regard among other things to local conditions and circumstances, to the current state of technical knowledge and to the financial implications. The 'means' to be employed include the design, installation, maintenance and manner and periods of operation of plant and machinery, and the acoustic design.
Environmental Noise (England) Regulations 2006 (amended) (Ref. 7.2)	The Environmental Noise (England) Regulations 2006 (as amended) implement the European Commission Directive 2002/49/EC (known as the Environmental Noise Directive or END). The Regulations entail Noise Action Plans to be adopted by central Government to manage and (where necessary) reduce environmental noise, including from roads. The current Noise Action Plan: Roads identifies a number of Important Areas (IAs) most affected by road noise, within which measures to reduce noise should be focussed. The Action Plan advises highways authorities take the following action within IAs: 'For each Important Area, identify proposed actions that will meet the vision and aims set out in the Government's policy on noise or state why, in their view, no further action can or needs to be taken in order to meet this objective'
Noise Insulation Regulations (NIR) 1975, as amended 1988 (Ref 7.3)	The NIR provides the framework to determine the entitlement to noise insulation treatment at eligible buildings (i.e. dwellings and other building used for residential purposes within 300m from the nearest point on the

Legislation	Summary
	new or altered highway). The following three conditions should be met for potential qualification under the NIR: The combined expected maximum noise traffic level, i.e. the relevant noise level from the new or altered highway together with any other traffic in the vicinity must not be less than the specified noise level, $L_{A10,18h}$ 68 dB; The relevant noise level is at least 1.0 dB more than the prevailing noise level, i.e. the total traffic existing before the works to construct or improve the highway were begun; The contribution to the increase in the relevant noise level from the new or altered highway must be at least 1.0 dB. The noise should be assessed at a reception point located 1 metre in front of the most exposed façade part of an external window or door of an eligible room. Traffic flows used in the calculations should be the highest expected in a period of 15 years after opening to traffic. The predictions will be normally undertaken using the Annual Average Weekly Traffic (AAWT).

POLICY

7.2.2. The applicable policy framework is summarised in **Table 7-2** below.

Table 7-2 - Noise and Vibration: Summary of Policy

Policy	Summary
National Policy	
National Planning Policy Framework, 2019 (NPPF) (Ref. 7.4)	The NPPF (revised February 2019 and amended June 2019) provides guidance and key objectives for local policy development. Relevant policies are outlined below: Paragraph 11 states (inter alia): Plans and decisions should apply a presumption in favour of sustainable development… For decision-taking this means:… approving development proposals that accord with an up-to-date development plan without delay; or where there are no relevant development plan polices, or the policies which are most important for determining the application are out-of-date, granting permission unless: the application of policies in this Framework [i.e. the NPPF] that protect areas or assets of particular importance provides a clear reason for refusing the development proposed; or any adverse impacts of doing so would significantly and demonstrably outweigh the benefit, when assessed against the policies in this Framework [i.e. the NPPF] taken as a whole" Paragraph 170 (inter alia): "Planning polices and decisions should contribute to and enhance the natural local environment by:…

Policy	Summary
	Preventing new and existing development from contributing to, being put at unacceptable risk from, or being adversely affected by, unacceptable levels of…noise… Paragraph 180 (inter alia): "Planning policies and decisions should also ensure that new development is appropriate for its location taking into account the likely effects (including cumulative effects) of pollution on health, living conditions and the natural environment, as well as the potential sensitivity of the site or the wider area to impacts that could arise from the development. In doing so they should: mitigate and reduce to a minimum potential adverse impacts resulting from noise from new development – and avoid noise giving rise to significant adverse impacts on health and the quality of life; identify and protect tranquil areas which have remained relatively undisturbed by noise and are prized for their recreational and amenity value for this reason".
Noise Policy Statement for England, 2010 (NPSE) (Ref 7.5)	The Noise Policy Statement for England (NPSE) outlines central Government vision, aims and principles for managing and controlling environmental noise affecting people. The NPSE describes key conceptual thresholds considered to represent the onset of the (adverse) effects of environmental noise: Lowest Observed Adverse Effect Level (LOAEL) – the level above which adverse effects on health and quality of life can be detected; below this threshold noise is considered to be in the No Observed Effect Level (NOEL) range. Significant Observed Adverse Effect Level (SOAEL) - the level above which significant adverse effects on health and quality of life can occur. Through the effective management and control of environmental, neighbour and neighbourhood noise within the context of Government policy on sustainable development, the three aims of the NPSE are defined as: Avoid significant adverse impacts on health and quality of life; Mitigate and minimise adverse impacts on health and quality of life; and Where possible, contribute to the improvement of health and quality of life.
Local Policy	
Arun District Local Plan 2011-2031 (Ref 7.6)	The Arun District Local Plan 2011 – 2031 replaced the existing 2003 Arun District Local Plan. Relevant policies relating to noise in the adopted Local Plan include policy QE DM1 (Noise Pollution), which requires that developers proposing new noise generating development must seek advice from an early stage to determine the level of noise assessment required. This policy indicates that the proposal will need to be supported by: "Evidence to demonstrate that there are no suitable alternative locations for the development; A noise report which provides accurate information about the existing noise environment, and the likely impact of the proposed development upon the noise environment. The report must also demonstrate that the development meets appropriate national and local standards for noise, as set out in

Policy	Summary
	Annex 1 of the Planning Noise Advice Document: Sussex, and any mitigation measures required to ensure noise is managed to an acceptable level; Evidence to demonstrate that the development will not impact upon areas identified and valued for their tranquillity, including Gaps Between Settlements which are important to the enjoyment of Arun's countryside, its habitat and biodiversity."

GUIDANCE

The applicable guidance documents are summarised in **Table 7-3** below.

Table 7-3 - Noise and Vibration: Summary of Guidance

Policy	Summary
British Standard 5228:2009+A1:2014 (Ref 7.7)	BS 5228:2009+A1:2014 'Code of practice for noise and vibration control on construction and open sites' provides advice on prediction methods, noise and vibration measurements and assessment of impacts.
Design Manual for Roads and Bridges (DMRB) LA111 (Ref 7.8)	The DMRB is a comprehensive manual providing wide-ranging guidance as well as requirements for the design and impact assessment for road development schemes in the UK. LA111 (2020) (Revision 2) provides requirements for evaluating noise and vibration impacts. This section highlights the use of the Calculation of Road Traffic Noise (CRTN) as the primary methodology for predicting road traffic noise and also describes threshold criteria for assessment in terms of the magnitude of noise change. LA111 guidance is further described in the Assessment Methodology section.
Calculation of Road Traffic Noise (Ref 7.9)	The Calculation of Road Traffic Noise (CRTN) memorandum describes the methodology to calculate the road traffic noise at a given distance from the highway. The methodology takes into account the intervening ground cover, road configuration and road layout. Noise levels are presented in terms of the noise descriptor $L_{A10,18h}$ which is the noise level exceeded for just 10% of the time between 0600 and 2400 hours. The method also predicts $L_{A10,1h}$ which is the noise level exceeded for just 10% of the time within any one hour period.
British Standard 4142:2014+A1:2019 (Ref 7.10)	British Standard 4142:2014+A1:2019 'Methods for rating and assessing industrial and commercial sounds' sets out a methodology for assessing noise from industrial sources. The method set out in BS 4142 compares a rating of the noise from the specific source being assessed with the background sound climate existing at relevant noise-sensitive receptors (NSRs) in the absence of the source operation. The difference in levels established is taken as an indication of the magnitude of the noise impact, subject to contextual considerations [from BS 4142]: "Typically, the greater this difference, the greater the magnitude of the impact.

Policy	Summary
	A difference of around +10 dB or more is likely to be an indication of a significant adverse impact, depending on the context. A difference of around +5 dB is likely to be an indication of an adverse impact, depending on the context. The lower the rating level is relative to the measured background sound level, the less likely it is that the specific sound source will have an adverse impact or a significant adverse impact. Where the rating level does not exceed the background sound level, this is an indication of the specific sound source having a low impact, depending on the context." It is clear from this guidance that context is an important consideration in the assessment. The examples included in BS 4142:2014+A1:2019 Annex A illustrate the contextual factors that may be of importance, for example: The magnitude of the differences between rating level and background sound; The character of the existing noise environment at receptors; History of noise issues (e.g. complaints) associated with the operator or the site of the specific source under assessment; The diurnal period during which impacts are identified, and the relevance to the type of receptor; and The location at which actual impacts on the receptor could occur, i.e. indoor or outdoor. BS 4142:2014+A1:2019 provides guidance on minimising and reporting factors likely to contribute to uncertainty in the assessment. This includes following best practice guidance with regards to measurement of sound levels.
Planning Practice Guidance (Ref 7.11)	The Planning Practice Guidance web-based resource that supports the NPPF. The guidance advises that local planning authorities' plan-making and decision making should take account of the acoustic environment and in doing so consider: Whether or not a significant adverse effect is occurring or likely to occur. Whether or not an adverse effect is occurring or likely to occur. Whether or not a good standard of amenity can be achieved.
Planning Noise Advice Document: Sussex (Ref 7.12)	This document provides advice for developers and consultants for planning applications in East and West Sussex. The document complements the aims in the Noise Policy Statement for England. Section 6, Transport Schemes, refers to DMRB HD213/11 as the guidance which should be followed for noise assessments related to road schemes. HD213/11 was withdrawn in 2019 and has been replaced by LA111 (revision 2) (Ref 7.8)

7.3 CONSULTATION, SCOPE, METHODOLOGY AND SIGNIFICANCE CRITERIA

CONSULTATION UNDERTAKEN TO DATE

Table 7-4 provides a summary of the consultation activities undertaken in support of the preparation of this chapter.

Table 7-4 - Noise and Vibration: Summary of Consultation Undertaken

Body / organisation	Individual / stat body / organisation	Meeting dates and other forms of consultation	Summary of outcome of discussions
Arun District Council	Environmental Health, Scoping Opinion	2nd May 2019	Close proximity of the existing noise sensitive residential and commercial premises (Murrell Gardens, on B233, Fontwell Avenue and Fordingbridge Industrial Estate) must be assessed in full and the findings / recommendations must be adhered to by the developer during the clearance works, ground works and construction phase. If there are recommended works from the report to scope the future protection of these noise sensitive dwellings and commercial buildings, these mitigation measures must be agreed approved by the LPA before construction. Reliance on the CEMP alone will not suffice.
Arun District Council	Chris Davis, Environmental Health Department	2nd July 2019	Telephone and email correspondence to agree locations and duration for the noise monitoring in advance of commencing the survey.
Arun District Council	Joanne Lewis, Environmental Health	5th March 2021	Discussions and agreement on additional information to be provided in response to the Regulation 25 request (see **Appendix 1.1**)

SCOPE OF THE ASSESSMENT

7.3.1. The scope of this chapter has been established through an ongoing scoping process. Further information can be found in **Chapter 5: Approach to EIA**.

7.3.2. This section provides an update to the scope of the assessment and re-iterates the evidence base for scoping out elements of the topic following further iterative assessment.

ELEMENTS SCOPED OUT OF THE ASSESSMENT

7.3.3. The elements shown in **Table 7-5** are not considered to give rise to likely significant effects as a result of the Scheme and have therefore not been considered within the ES.

Table 7-5 - Elements Scoped Out of the Assessment

Element scoped out	Justification
Noise generated by construction-related vehicular movements	Potential impacts of noise generated by construction-related vehicular movements along the existing road network and then accessing into the Site are considered not to be significant. The additional construction-related HGV vehicle movements to and from the Site are anticipated to be minimal in the context of the existing traffic flows
Operational vibration	Given the nature of the Scheme, it is expected that levels of vibration during the operational phase are unlikely to be significant at the identified sensitive receptors

ELEMENTS SCOPED INTO THE ASSESSMENT

Construction Phase

7.3.4. The following elements are considered to have the potential to give rise to likely significant effects during construction of the Scheme and have therefore been considered within the ES:

- Disturbance to sensitive receptors from the generation of noise and vibration from on-site activities during the construction phase of the Scheme.

Operation Phase

7.3.5. The following elements are considered to have the potential to give rise to likely significant effects during operation of the Scheme and have therefore been considered within the ES:

- Disturbance to noise sensitive receptors from noise generated by road traffic on the Scheme;
- Disturbance to noise sensitive receptors from noise level changes generated by a combination of changes in road traffic flow and / or composition on existing roads as a result of the Scheme; and
- Disturbance to noise sensitive receptors from noise generated by the relocated substation.

EXTENT OF THE STUDY AREA

7.3.6. The study area has been defined in accordance with DMRB LA111 (Revision 2) (Ref 7.8) and is illustrated in **Figure 7-1: Noise Assessment Study Area, Sensitive Receptors and Noise Survey Locations**. The following steps were used to determine the study area:

- A 600m area from the Scheme and roads links physically changed or bypassed by the Scheme; and
- A 50m area from other road links with the potential to experience a Basic Noise Level (BNL) change of more than 1dB(A) in the short term or more than 3 dB(A) in the long term, as a result of the Scheme.

7.3.7. Guidance within BS 5228 (Ref 7.7), which has been used to assess the potential impacts during construction, states that at distances beyond 300m, noise predictions should be treated with caution. Similarly, for predicted vibration levels at distances greater than 100 m there is uncertainty. Therefore, the study area for potential construction effects is limited to these distances from the Scheme.

7.3.8. The study area adopted for the assessment of potential construction effects and noise from the relocated substation has focused on the closest noise sensitive receptors. These receptors are also representative of neighbouring properties in their vicinity. By choosing a selection of the closest identified potentially sensitive receptors the reported impacts are, therefore, typical of the worst affected receptors and all potentially significant effects are identified. At receptors further away from the works the impact would be reduced.

METHOD OF BASELINE DATA COLLATION

DESK STUDY

7.3.9. A review of the Strategic Noise maps published by Department of Environment, Farming and Rural Affairs (DEFRA) (Ref 7.13) under the requirements of the Environmental Noise (England) Regulations 2006 (as amended) (Ref 7.2) show that there are no Noise Action Planning Important Areas (IAs) within the study area of the Scheme. IAs are identified by DEFRA as locations where the top 1% of the population that are exposed to the highest noise levels is located. The closest IA identified to the Scheme is associated with rail noise and located at Barnham station (RI_550), approximately 950 m south west of the Scheme. The closest IA for road noise is located on the A27 at Fontwell, approximately 1.2 km north of the Scheme and outside of the study area for the Scheme.

SURVEYS

7.3.10. A baseline noise survey was carried out between 10th and 19th July 2019. The locations and survey methodology were agreed with the Environmental Health Officer (EHO) at Arun District Council prior to the commencement of the monitoring (see **Table 7-4**). The purpose of the noise monitoring was to establish the existing noise environment and validate the accuracy of the noise model predictions.

7.3.11. The measurements were taken in accordance with BS 7445 (Ref 7.14), CRTN (Ref 7.9) and BS 4142: 2014+A1: 2019 (Ref 7.10).

7.3.12. Measurements were taken in free-field conditions at a height of approximately 1.5 m. Third-octave band noise levels were recorded at intervals of 15-minutes (L_{Aeq}, L_{Amax}, L_{Amax}, L_{A10} and L_{A90}), along with 1 second fast time-weighted sound pressure levels.

7.3.13. Weather conditions during the survey were suitable for noise measurements as set out in BS 7445, with no rain and light winds.

7.3.14. Monitoring was conducted using Class 1 Sound Level Meters. A field calibrator was used to calibrate and check the meter before and after the measurement period with no change in

level recorded. Specific details of the equipment used, including serial numbers and calibration dates is provided in Noise Monitoring Forms contained with **Appendix 7.1**.

7.3.15. Long-term unattended measurements were taken at four locations and short-term attended measurements taken at four further locations which are described in **Table 7-6**. **Figure 7-1: Noise Assessment Study Area, Sensitive Receptors and Noise Survey Locations** shows the location of the measurements.

Table 7-6 - Baseline Noise Monitoring Locations

Monitoring ID	Location	Duration and Description of Survey	Rationale
LT1	Fields north of Barnham Road at site of Barratts Development immediately adjacent to the Scheme	4 days unattended	Establish baseline noise levels for proposed residential development.
LT2	Barnham Road (B2233)	5 days unattended	Long-term Calculation of Road Traffic Noise (CRTN) measurement to establishing road traffic noise levels on B2233.
LT3	Fields west of Downview Road	5 days unattended	Establish baseline noise levels for noise sensitive receptors on Ewens Gardens.
LT4	Orchard Farm, Eastergate Lane	4 days unattended	Establish baseline noise levels for noise sensitive receptors north of the Scheme and contribution from road traffic on Eastergate Lane.
ST1	Fields north of Fordingbridge Industrial Estate (Halo), at site of Barratts Development immediately adjacent to the Scheme	3 x 15 minutes attended during daytime	CRTN comparative measurement procedure for model verification.
ST2	Barnham Road, between Halo site and Downview Road	2 x 15 minutes attended during daytime	CRTN shortened measurement procedure for model verification to quantify road traffic noise from B2233 as a predominant noise source in the area.
ST3	Fontwell Avenue, A29	2 x 15 minutes attended during daytime	CRTN shortened measurement procedure for model verification to quantify road traffic noise from A29 as a predominant noise source in the area.
ST4	Fontwell Avenue, A29 – junction with Wandley's Lane	2 x 15 minutes attended during daytime	CRTN shortened measurement procedure for model verification to quantify road traffic noise from

			A29 as a predominant noise source in the area.

ASSESSMENT METHODOLOGY

Construction Noise

7.3.16. The likely construction noise levels have been predicted using the methodology set out in BS 5228 (Ref 7.7). At this stage, before contractors have been appointed to construct the Scheme, precise information on the construction works is not available. However, a contractor has been appointed to provide reasonable assumptions on the likely works. Therefore, the estimated construction noise levels are based on information which includes the number and type of plant likely to be required for each activity, typical 'on' times for each item of plant, working areas, working times and durations. Further details on the activities and plant throughout the construction works are provided in **Appendix 7.2**.

7.3.17. Construction noise levels are predicted as a 'free-field' equivalent continuous noise level averaged over the assessment period ($L_{Aeq,T}$), corrected to account for the variations in noise due to plant-on / plant-off time during the assessment period.

7.3.18. Estimates of reasonable worst-case construction noise levels have been made for a selection of 7 of the closest identified potentially sensitive receptors to the works. These selected receptors are also representative of neighbouring properties in their vicinity. By choosing a selection of the closest identified potentially sensitive receptors the reported impacts are, therefore, typical of the worst affected receptors and all potentially significant effects are identified. At receptors further away from the works the impact would be reduced.

7.3.19. The significance of construction noise effects is assessed on the category threshold for the noise sensitive receptor as required in the ABC assessment methodology set out by BS 5228, shown in **Table 7-7**.

Table 7-7 - BS 5228 ABC Construction Noise Assessment Categories

Evaluation Period	Assessment Category dB (L_{Aeq})		
	A	B	C
Night-time (23:00-07:00)	45	50	55
Evening and Weekends*	55	60	65
Daytime (07:00-19:00)	65	70	75

* 19:00-23:00 weekdays, 13:00-23:00 Saturdays and 07:00-23:00 Sundays.

Category A: threshold values to use when ambient Noise levels (when rounded to the nearest 5 dB) are less than these values.

Category B: threshold values to use when ambient Noise levels (when rounded to the nearest 5 dB) are the same as Category A values.

Category C: threshold values to use when ambient Noise levels (when rounded to the nearest 5 dB) are higher than Category A values.

The Category (A, B or C) is to be determined separately for each time period and the lowest Noise category is then used throughout the 24-hour cycle, e.g. a site which is category A by day and category B or C in the evening and night will be treated as category A for day, evening and night.

7.3.20. The methodology identifies potential significant effects where predicted noise levels exceed Categories A and B. These categories consider the impact of construction in locations with lower existing ambient noise levels. Where construction noise levels are predicted to exceed the A or B Categories, but are less than the Category C threshold, then this is assessed as potentially significant in quieter areas.

7.3.21. When considering construction noise effects in terms of the Lowest Observed Adverse Effect Level (LOAEL) and Significant Adverse Effect Level (SOAEL) as described in the NPSE (Ref. 7.5), the approach as set out in DMRB LA111 (Ref.7.7) has been adopted. The LOAEL value is not fixed and will depend on the measured (or derived representative) baseline noise level at each receptor location. The SOAEL value is aligned with the ABC assessment values shown in **Table 7-7**.

Construction Vibration

7.3.22. Some construction activities can be a source of ground-borne vibration, which can be a cause for concern at the nearest receptors. The main sources of ground borne vibration are anticipated to be from compacting activities in close proximity to adjacent sensitive receptors. Impacts are considered for both damage to buildings and annoyance to occupiers.

7.3.23. BS 7385 (Ref 7.15) establishes the basic principles for carrying out vibration measurements and processing the data with regard to evaluating vibration impacts on buildings. **Table 7-8** provides recommended peak particle velocity (PPV) vibration limits for transient excitation for different types of buildings (as set out in BS 7385-2). The PPV values in **Table 7-8** are given in two ranges as very low frequency vibration (between 4Hz to 15Hz) is potentially more damaging to light framed building structures, and therefore has a lower threshold.

Table 7-8 - Peak Particle Velocity (PPV) Limits for Cosmetic Damage

Type of Building	Peak Component Particle Velocity in Frequency Range of Predominant Pulse[1]	
	4 Hz to 15 Hz	15 Hz and above
Reinforced or framed structures. Industrial and heavy commercial buildings.	50 mm/s at 4 Hz and above	50 mm/s at 4 Hz and above
Un-reinforced or light framed structures. Residential or light commercial type buildings[2]	15 mm/s at 4 Hz increasing to 20 mm/s at 15 Hz	20 mm/s at 15 Hz increasing to 50 mm/s at 40 Hz and above

[1] Values referred to are at the base of the building.

[2] At frequencies below 4 Hz a maximum displacement of 0.6 mm (zero to peak) should not be exceeded

7.3.24. BS 7385-2 states that the probability of building damage tends towards zero for transient vibration levels less than 12.5 mms-1 PPV. For continuous vibration, such as from vibratory rollers, the threshold is around half this value.

7.3.25. It is also noted that these values refer to the likelihood of cosmetic damage. ISO 4866:2010 (Ref 7.16) defines three different categories of building damage:

- Cosmetic – formation of hairline cracks in plaster or drywall surface and in mortar joints of brick concrete block constructions;
- Minor – formation of large cracks or loosening and falling of plaster or drywall surface or cracks through brick/block; and
- Major – damage to structural elements, cracks in support columns, loosening of joints, splaying of masonry cracks.

7.3.26. BS 7385-2 defines that minor damage occurs at a vibration level twice that of cosmetic damage and major damage occurs at a vibration level twice that of minor damage. Therefore, this guidance has been used to define the magnitude of impact identified in **Table 7-9** for continuous vibration.

Table 7-9 - Construction Vibration Magnitude of Impact Criteria for Assessment Building Damage

Magnitude of Impact	Damage Risk	Continuous Vibration Level PPV mms-1
Negligible	Negligible	< 6
Minor	Cosmetic	6
Moderate	Minor	15
Major	Major	30

In addition to building damage, BS 5228-2 (Ref 7.7) contains guidance on PPV vibration levels and provides a semantic scale for the description of construction vibration effects on human receptors. The criteria adopted to assess the potential impacts to nearby receptors for this study are set out in **Table 7-10**.

Table 7-10 - Construction Vibration Magnitude of Impact Criteria for Human Receptors (Annoyance)

Peak Particle Velocity (PPV) mms-1	Description	Magnitude of Impact
0.14 to < 0.3	Vibration might be just perceptible in the most sensitive situations for most vibration frequencies associated with construction. At lower frequencies, people are less sensitive to vibration	Negligible
0.3 to < 1	Vibration might be just perceptible in residential environments	Minor
1.0 to < 10	It is likely that vibration of this level in residential environments will cause complaint, but can be tolerated if prior warning and explanation has been given to residents	Moderate
≥ 10	Vibration is likely to be intolerable for any more than a very brief exposure to this level	Major

7.3.27. For human receptors the LOAEL is defined as a PPV of 0.3 mms-1, this being the point as which construction vibration is likely to become perceptible. The SOAEL is defined as a PPV

of 1.0 mms-1, this being the level at which construction vibration can be tolerated with prior warning. These values are in line with guidance in DMRB LA111, Table 3.31 (Ref 7.8).

Operation Road Traffic Noise

7.3.28. The assessment of operational road traffic noise has been undertaken in line with guidance set out in DMRB (Ref 7.8).

7.3.29. Noise from a flow of road traffic is generated by both the vehicle engines and the interaction of tyres with the road surface. The traffic noise level at a receptor, such as an observer at the roadside or residents within a property, is influenced by a number of factors including traffic flow, speed, composition (percentage of HGVs), road gradient, type of road surface, distance from the road and the presence of any obstructions between the road and the receptor.

7.3.30. Noise from a stream of traffic is not constant, but to assess the noise impact a single figure estimate of the overall noise level is necessary. The index adopted by the Government in 'The Calculation of Road Traffic Noise' (CRTN) (Ref 7.9) to assess traffic noise is $L_{A10,18h}$. This value is determined by taking the highest 10% of noise readings in each of the 18 one-hour periods between 06:00 and 00:00, and then calculating the arithmetic mean.

7.3.31. CRTN provides the standard methodology for predicting the $L_{A10,18h}$ road traffic noise level. Noise levels are predicted at a point measured 1 m horizontally from the external façade of buildings.

7.3.32. Although the main focus of the assessment is on daytime impacts, DMRB also requires an assessment of night-time (i.e. between 23:00 and 07:00) traffic noise levels ($L_{night,outside}$). DMRB refers to three methods for calculating night-time traffic noise levels developed by the Transport Research Laboratory (TRL) (Ref 7.16). Night-time traffic noise levels have been calculated using Method 3.

7.3.33. Predicted daytime and night-time traffic noise levels for the operational phase have been generated using a 3D computer noise model created using CadnaA 2020 and ArcGIS 10.4.1 software. The following parameters and assumptions were used in the noise model:

- CRTN calculation procedures;
- Topographic data at 2m height intervals;
- OS Addresspoint data;
- Building height derived from LIDAR data with new buildings, or those for which data is missing, at a height of 6m;
- Receptor façade noise levels calculated at 4m (first floor);
- Ground absorption value of 0.5;
- 18 hr AAWT traffic flows (0600 – 2400hrs) with average speed (kph) and percentage of heavy vehicles defined as vehicles with a weight greater than 3.5 tonnes;
- Scheme horizontal and vertical alignment;
- 30 mph (48 kph) speed limit on Scheme; and
- Noise mitigation feature with a height of 3m and length of approximately 440m; the northern section (approximately 280m) has been modelled as absorptive (see **Figure 7.5** and **Figure 7.6**).

7.3.34. For the purposes of this assessment, the following scenarios have been modelled:

- Existing/baseline year (2017). This scenario was used to validate the noise model against the noise monitoring;
- Do-minimum opening year (DMOY) as 2023;
- Do-minimum future year (DMFY) as 2038;
- Do-something (with Scheme) opening year (DSOY); and
- Do-something (with Scheme) future year (DSFY).

7.3.35. The DSFY has been modelled using traffic flows which assume Phase 2 of the A29 Realignment has been constructed (in addition to other schemes as set out in **Chapter 14: Cumulative Effects**). Phase 2 of the A29 Realignment is located to the south of the Scheme from the junction with Barnham Road to re-join the existing A29 south of Westergate. Whilst noise generated by traffic on any new road which forms Phase 2 will be assessed as part of any future planning application, the changes in traffic flow on Phase 1 (i.e. the Scheme) and associated noise has been included in this assessment. This represents a worst-case scenario in terms of increased traffic flow and noise increase at properties within the study area for the Scheme.

7.3.36. In line with DMRB LA111 guidance, the following comparisons have been undertaken for the predicted change in road traffic noise:

- Short term noise change comparing the DMOY with the DSOY for both day-time (0600 – 2400hrs) and night-time (2300 – 0700 hrs) periods;
- Long term noise change comparing the DMOY with the DSFY for both day-time (0600 – 2400hrs) and night-time (2300 – 0700 hrs) period; and
- Non-project change comparing the DMOY with the DMFY for both day-time (0600 – 2400hrs) and night-time (2300 – 0700 hrs) periods.

7.3.37. Day-time noise contours have been prepared for the comparisons listed above and are presented in the associated figures for this chapter (**Figure 7.2** – **Figure 7.4**). Assessment tables, providing the number of sensitive receptors predicted to experience an increase or decrease in road traffic noise levels, for these comparisons are provided in **Appendix 7.3**.

7.3.38. The calculated absolute noise levels produced have also been analysed to indicate the potential eligibility for compensation under the Noise Insulation Regulations 1975 (as amended) (Ref 7.3) and to assess the implications in respect to the NPSE (Ref 7.5).

7.3.39. The magnitude of change for the short term and long-term operational noise impacts presented in DMRB LA111, and replicated in **Table 7-11**, have been used to inform the initial assessment of likely significant effects.

Table 7-11 - Magnitude of Traffic Noise Impacts

Short Term Change		Long Term Change	
Noise Level Change, dB ($L_{A10, 18h}$ or L_{night})	Magnitude of Impact	Noise Level Change, dB ($L_{A10, 18h}$ or L_{night})	Magnitude of Impact
0	No Change	0	No Change
0.1 - 0.9	Negligible	0.1 - 2.9	Negligible
1 - 2.9	Minor	3 - 4.9	Minor

3 - 4.9	Moderate	5 – 9.9	Moderate
5+	Major	10+	Major

7.3.40. For noise sensitive receptors where the magnitude of change in the short term is either minor, moderate or major and therefore there is a potential for a significant effect, other factors have been considered to determine final significance. This approach is set out in DMRB LA111 and lists the following factors to be considered:

- Magnitude of noise level change within 1 dB of minor/moderate classification boundary;
- Differing magnitude of impact in the long term to magnitude of impact in the short term;
- Absolute level with reference to the LOAEL and SOAEL;
- Location of the noise sensitive parts of the receptors;
- Acoustic context; and
- Likely perception of change by residents.

7.3.41. The operational road traffic LOAEL and SOAEL for all noise sensitive receptors presented in DMRB LA111 and replicated in **Table 7-12** have been used in the assessment.

Table 7-12 - Operational road traffic noise LOAEL and SOAELs

Time Period	LOAEL	SOAEL
Day (06:00 – 24:00)	55 dB $L_{A10, 18hr\ facade}$	68 dB $L_{A10, 18hr\ facade}$
Night (23:00 – 07:00)	40 dB $L_{night, outside\ (free\text{-}field)}$	55 dB $L_{night, outside\ (free\text{-}field)}$)

Relocated Substation

7.3.42. The methodology for the assessment of noise from the relocated substation has been undertaken with consideration to the guidance contained in BS 4142:2014+A1:2019 (Ref 7.10) and outlined in **Table 7-3**.

7.3.43. In considering the relevant SOAEL and LOAEL for fixed plant (e.g. the substation), BS 4142 states a rating level 10 dB above the background sound level, is likely to be an indication of significant adverse impact, depending on context. Therefore, this has been taken as indicative of the SOAEL, depending on context. A rating level of 5 dB above the residual noise level at receptors is likely to be an indication of an adverse impact, depending on context. Where the rating level does not exceed the background sound level, this is an indication of low impact, depending on context. Therefore, the LOAEL, again depending on context, falls between 0-5 dB above the background sound level.

SIGNIFICANCE CRITERIA

7.3.44. The significance level attributed to each effect has been assessed based on the sensitivity/value of the affected receptor(s) and the magnitude of change arising from the Scheme, as well as a number of other factors that are outlined in more detail in **Chapter 5: Approach to EIA**. The sensitivity of the affected receptor is assessed on a scale of high, medium, low and negligible, and the magnitude of change is assessed on a scale of large, medium, small, negligible and no change, as set out in **Chapter 5: Approach to EIA.**

7.3.45. For noise and vibration, all sensitive receptors within the study area have been considered as having a high sensitivity value.

EFFECT SIGNIFICANCE

7.3.46. The following terms have been used to define the significance of the effects identified and apply to both beneficial and adverse effects:

- **Major effect**: where the Scheme could be expected to have a substantial improvement or deterioration on receptors;
- **Moderate effect**: where the Scheme could be expected to have a noticeable improvement or deterioration on receptors;
- **Minor effect**: where the Scheme could be expected to result in a perceptible improvement or deterioration on receptors; and
- **Negligible**: where no discernible improvement or deterioration is expected as a result of the Scheme on receptors, including instances where no change is confirmed.

As set out in **Chapter 5: Approach to EIA**, effects that are classified as **moderate or above** are considered to be **significant**. Effects classified as minor or below are considered to be **not significant**.

7.4 BASELINE CONDITIONS

Table 7-13 and **Table 7-14** present a summary of the baseline noise survey results. This information has been used to validate the noise model. A complete set of results in presented in **Appendix 7.1**.

Table 7-13 - Long Term Unattended Noise Survey Results

Measurement Location	Road Traffic Noise Level, $L_{A10,T}$ dB		Typical Ambient Sound Level, L_{Aeq} dB		Typical Background Sound Level, L_{A90} dB	
	Daytime (06:00 – 24:00)	Night-time (23:00 – 07:00)	Daytime (07:00 – 23:00)	Night-time (23:00 – 07:00)	Daytime (07:00 – 23:00)	Night-time (23:00 – 07:00)
LT1	45	40	44	40	38	26
LT2	67	53	63	57	49	23
LT3	47	39	46	41	46	30
LT4	45	40	47	43	42	32

Table 7-14 - Short Term Attended Noise Survey Results (Daytime)

Measurement Location	Road Traffic Noise Level, $L_{A10,T}$ dB	Typical Ambient Sound, $L_{Aeq,T}$ dB	Typical Background Sound Level, $L_{A90,T}$ dB
ST1	44	42	38
ST2	75	71	51
ST3	68	65	52
ST4	74	60	51

7.4.1. The baseline noise survey results show that road traffic is the dominant noise source across the study area. Locations close to Barnham Road (LT2 and ST2) and Fontwell Avenue (ST3 and ST4) are exposed to high levels of road traffic noise during the daytime (67 dB $L_{A10, 18h}$ and 68-75 dB $L_{A10, 15min}$). During the night-time, road traffic noise levels fall to approximately 53dB $L_{A10, T}$.

7.4.2. At locations further away from the main road links, along the route of the Scheme (LT1, LT3, LT4 and ST1), ambient daytime sound levels range between 42-47 dB $L_{Aeq,T}$. During the night-time, ambient sound levels range between 40-43 dB $L_{Aeq, T}$.

FUTURE BASELINE

7.4.3. Future baseline noise levels have been modelled in accordance with DMRB LA111 for the opening year (2023) and future year (2038). The non-project change (DMFY compared to the DMOY) is presented in **Table 7-15**.

Table 7-15 - Do–minimum (Years 2023 and 2038) Traffic Noise Reporting Table

Impact; Change in noise level			Daytime $L_{A10, 18h}$ dB (0600 – 2400h)	
			Number of Dwellings	Number of other sensitive receptors
Adverse; Increase in noise level, dB	Negligible	< 3	1,745	13
	Minor	3 – 4.9	1	0
	Moderate	5 – 9.9	0	0
	Major	10 +	0	0
No Change		0	1	0
Beneficial; Decrease in noise level, dB	Negligible	< 3	45	2
	Minor	3 – 4.9	0	0
	Moderate	5 – 9.9	0	0
	Major	10 +	0	0
Totals			1,792	15

7.4.4. In the long term, the noise modelling results show that approximately 97% of residential properties within the study area would experience a negligible increase in noise level (less than 3 dB) during the daytime in the DMFY scenario in comparison to the DMOY. Properties subject to either no change or a decrease in noise level would equate to approximately 3% of the total number of dwellings studied. One dwelling would be subject to a minor increase in noise level without the Scheme in the DMFY. All other noise-sensitive receptors would experience a negligible change in noise level.

7.4.5. The predicted noise levels are based on the traffic data provided. The traffic modelling includes the trip generation resulting from committed developments in the area (refer to Traffic Forecasting Report' for details). These forecasts include growth in traffic as a result of

future developments, and forecasts have been produced in line with DfT guidance. These are described in more detail in the Transport Assessment (**Appendix 8.1**).

7.4.6. The predicted future baseline noise levels in 2023 have been used to determine the ambient baseline noise level (LAeq) for the day (07:00 – 19:00) calculated using Method 3 for non-motorway roads set out in Transport Research Laboratory (TRL) report for converting traffic noise (Ref 7.16). These noise levels have been used to establish the LOAEL at representative receptors using the assessment of construction noise and are provided in **Appendix 7.2**.

7.5 SENSITIVE RECEPTORS

7.5.1. The following definitions taken from guidance within DMRB LA111 (Ref 7.8), have been used to identify sensitive receptors within the study to include within the assessment:

- Noise sensitive receptors including dwellings, hospitals, healthcare facilities, education facilities, community facilities, Environmental Noise Directive (END) quiet areas, international and national or statutorily designated sites, public rights of way and cultural heritage assets; and
- Vibration sensitive receptors including dwellings, hospitals, healthcare facilities, education facilities, community facilities, buildings containing vibrations sensitive equipment and cultural heritage.

7.5.2. All key sensitive receptor locations are shown on **Figure 7-1: Noise Assessment Study Area**, Sensitive Receptors and Noise Survey Locations.

7.5.3. A request for a Scoping Opinion has been made to Arun District Council in respect of a residential development with up to 500 dwellings, a care home and public open space on land adjacent to the Scheme between Eastergate Lane and Barnham Road (planning ref BN/122/19/EIS) (known as 'the Adjacent Proposed Development'). A Scoping Opinion was issued by Arun District Council in April 2020 (Ref 7.18). The Scoping Opinion requires any planning application for the site to be supported by a noise and vibration report which considers 'the proposed A29 with regard to traffic flow, noise and vibration' (i.e. the Scheme). As the Scheme would be constructed before, or in parallel with, any new development, it is not appropriate to determine a 'before' Scheme noise level and therefore to assess the change in noise level at these locations as required in the DMRB guidance.

7.5.4. There is also a recommendation in the Scoping Opinion that 'the design of dwellings will feature glazing and façade treatments to meet the relevant standards, taking into account the proposed highway'. As the requirement to achieve acceptable levels of noise at new dwellings from road traffic noise, including that generated by the Scheme, will be with the developer, the noise impact at these future receptors has been scoped out of this assessment.

7.5.5. However, as part of the iterative design process for the Scheme, discussions have been held with the developer and the proposed outline site layout has been reviewed. As part of the iterative design process for the noise mitigation feature which forms part of the Scheme design, the use of an absorptive material is proposed for the north section (approximately 280 m) which faces the site of the potential new residential development. This is to reduce the potential for the reflection of noise from the noise mitigation barrier positioned on the eastern side of the Scheme to any new dwellings on the western side of the Scheme.

7.6 ASSESSMENT OF EFFECTS, MITIGATION AND RESIDUAL EFFECTS

CONSTRUCTION PHASE

7.6.1. During the construction phase, the contractor will apply Best Practicable Means (BPM) as defined under Section 72 of the CoPA (Ref 7.1) to minimise noise and vibration impact. As set out in **Chapter 3: Description of the Scheme**, the normal site working (construction) hours are proposed to be the following which are in keeping with the LPA guidelines:

- Monday to Friday 7:00 to 18:00 (please note, Noise Generating Activities (as defined by BS 5228) will be limited to an 8:00 start); and
- Saturdays 8:00 to 13:00.

7.6.2. Normal site operations are expected to be limited to the hours above. However, should works outside the hours specified above (including night-time working) be required then prior consent would need to be sought from the LPA under Section 61 of the Control of Pollution Act 1974.

7.6.3. The anticipated duration of construction works is 12 months.

Noise

7.6.4. Construction activity inevitably leads to some degree of noise disturbance at locations in close proximity to the construction activities. It is, however, a temporary source of noise. The noise levels generated by construction activities would have the potential to impact upon nearby noise sensitive receptors. Noise levels at any one location will vary as different combinations of plant and machinery are used and throughout the construction of the Scheme as the construction activities and locations change.

7.6.5. The LOAEL and SOAEL used in the assessment of construction noise for representative receptors, as determined by the predicted ambient day-time noise level ($L_{Aeq, 12h}$) and the BS 5228 guidance (Table 7) respectively. These are provided in **Appendix 7.2**.

The assessment of likely impacts from noise during construction is summarised in **Table 7-16** and further details presented in **Appendix 7.2**.

Table 7-16 - Noise (Construction)

Assessment Component	Commentary
Disturbance to sensitive receptors from the generation of noise from on-site activities during the construction phase of the Scheme	The predicted construction noise levels at the representative noise sensitive receptors closest to the construction works are presented in Appendix 7.2. These are worst-case predicted noise levels based on all plant working at the closest approach. During setup of the three site compounds, it is unlikely that noise levels generated would exceed the relevant LOAEL or SOAEL at the representative receptors. During other phases of the constructions works, there is the potential risk that the SOAEL would be exceeded at times during the construction works when working at the closest approach to receptors.

	Guidance in BS 5228-1 and DMRB LA111 states that a significant impact is deemed to occur if the duration of construction noise exceeds 10 or more days or nights in any consecutive days or nights, or more than 40 days (or nights) in any 6 consecutive months. The scheduling of construction works will be determined by the contractor. However, it is anticipated that construction activities, working at the closest approach to receptors, and generating noise which exceed the durations specified, is unlikely. The sensitivity of receptors is considered to be high, and the magnitude of change prior to mitigation, is considered to be major. Therefore, there is likely to be a temporary, short-term major adverse effect on receptors (significant) prior to the implementation of mitigation measures.
Secondary Mitigation	During the construction phase, the contractor will apply Best Practicable Means (BPM) as defined under Section 72 of the CoPA (Ref 7.1) to minimise noise and vibration impact. General methods of control will include: The appropriate selection of plant, construction methods and programming: Only plant conforming with or better than relevant national or international standards, directives or recommendations on noise or vibration emissions will be used. Construction plant will be maintained in good condition with regards to minimising noise output and workers exposed to harmful noise and vibration; Construction plant will be operated and maintained appropriately, having regard to the manufacturer's written recommendations or using other appropriate operation and maintenance programmes which reduce noise and vibration emissions. All vehicles and plant will be switched off when not in use; Design and use of site hoardings and screens, where necessary, to provide acoustic screening at the earliest practicable opportunity. Where practicable, gates will not be located opposite buildings containing NSRs; Choice of routes and programming for the transport of construction materials, spoil and personnel to reduce the risk of increased noise and vibration impacts due to the construction of the junction; Vehicle and mechanical plant used for the purpose of the works will be fitted with effective exhaust silencers, be maintained in good working order and operated in such a manner as to minimise noise emissions. Plant items that comply with the relevant EU/UK noise limits applicable to that equipment will be used; Construction plant and activities will be positioned to minimise noise at sensitive locations; Equipment that breaks concrete by munching or similar, rather than by percussion, will be used as far as is practicable; and Mufflers will be used on pneumatic tools. The localised use of temporary site hoardings or noise barriers has not been included in the assessment of construction noise in order to represent a worst-case scenario. BS 5228 advises that noise barriers can provide a reduction in noise levels of 5 dB when the top of the plant is just visible over the noise barrier, and 10 dB when the plant is completely screened from a receptor. The effectiveness of a noise barrier depends upon its length, effective

	height, position relative to the noise source and to the receptors, and the material from which it is constructed.
Residual Effects and Monitoring	The sensitivity of receptors is high and the magnitude of change, following mitigation, is moderate. Therefore, there is likely to be a direct, temporary, short-term moderate adverse residual effect on receptors (significant) following the implementation of mitigation measures.

Vibration

7.6.6. The activities likely to generate potentially significant vibration levels during construction are earthworks including landscaping, road construction (pavement) and other works using vibratory rollers or compactors. Vibration levels have been calculated in accordance with the procedures set out in BS 5228-2 (Table E.1). Source data for vibratory rollers and compactors have been taken from TRL Report 429 'Groundborne vibration caused by mechanised construction works' (Ref 7.19). Predicted maximum PPV levels at receptors are provided in **Appendix 7.2**.

7.6.7. For human receptors the LOAEL is defined as a PPV of 0.3 mms-1, this being the point at which construction vibration is likely to become perceptible. The SOAEL is defined as a PPV of 1.0 mms-1, this being the level at which construction vibration can be tolerated with prior warning.

7.6.8. The assessment of likely impacts from vibration during construction is summarised in **Table 7-17**.

Table 7-17 - Vibration (Construction)

Assessment Component	Commentary
Disturbance to sensitive receptors from the generation of vibration from on-site activities during the construction phase of the Scheme	The predicted maximum PPV levels at the representative receptors closest to the construction works are presented in Appendix 7.2 for activities using vibratory rollers or compactors. There is a risk of the SOAEL being exceeded during works undertaken using vibratory compactors or rollers when working at the Barnham Road and Footwell Avenue roundabouts/junction, when in close proximity to receptors. For building damage, BS 7385-2 guidance indicates that for levels of continuous vibrations below 6.0 mms-1, the risk of building damage is negligible (see Table 7-9). The predicted levels do not exceed this level of vibration at any receptor location. Therefore, the risk for potential building damage during construction is considered negligible. The sensitivity of receptors is considered to be high, and the magnitude of change prior to mitigation, is considered to be major. Therefore, there is likely to be a direct, temporary, short-term major adverse effect on receptors (significant) prior to the implementation of mitigation measures.
Secondary Mitigation	During the construction phase, the contractor will apply Best Practicable Means (BPM) as defined under Section 72 of the CoPA (Ref 7.1) to minimise noise and vibration impact. Specific methods of control for vibration will include:

	▪ Selection of low vibratory equipment and methodologies; ▪ Contact details for nominated site contact for local residents to deal with complaints and engaging with local residents; and ▪ No start-up or shut down of vibratory plant e.g. rollers or compactors, within 50 m of receptors so as to prevent exceedance of the SOAEL.
Residual Effects and Monitoring	The sensitivity of receptors is high and the magnitude of change, following mitigation, is minor/moderate. Therefore, there is likely to be a direct, temporary, short-term minor/moderate adverse residual effect on receptors (not significant) following the implementation of mitigation measures.

OPERATIONAL PHASE

7.6.9. The Scheme design includes a 3 m high noise mitigation feature with a length of approximately 440 m. As part of the iterative design process, the height and extent of the noise mitigation feature has been optimised within the engineering constraints of the Scheme, namely:

- Off-set from the carriageway edge by 3 m to allow for drainage and road signs;
- A maximum overall height of 3 m due to land constraints and limited width available at the southern end of the Scheme; and
- Location of attenuation pond constrained due to the vertical alignment of the road in order to provide a suitable drainage solution.

7.6.10. Due to the speed limit of the Scheme (30 mph), the use of a thin surfacing or 'low noise' material would provide a negligible reduction in road traffic noise levels and is therefore not proposed as part of the Scheme.

Operational Road Traffic Noise

7.6.11. The magnitude of change has been derived by comparing the do-minimum scenario in the opening year (DMOY) against the do-something scenario the opening year (DSOY) (short term change) and the future year (DSFY) (long term change). This provides an initial assessment for establishing potential significant noise effects. The Scheme design includes a noise mitigation feature with a height of 3 m, the location of which is shown in **Figure 7-5** and **Figure 7-6**.

7.6.12. The number of dwellings with the potential to qualify under the Noise Insulation Regulations 1975 (amended 1988) (Ref 7.3), have been identified.

7.6.13. Figures have been prepared from the results of the noise model to support the assessment focus on the magnitude of impacts (change) and location of dwellings between the LOAEL and SOAEL. The following figures have been prepared:

- Magnitude of impact DMRB noise change contours: The noise impact in accordance with DMRB LA111 (Ref 7.8) for short term and long term. Noise contours have been plotted at a height of 4 metres; and
- Location of dwellings exceeding the LOAEL, where a moderate or major magnitude of change (increase), in the short term and long term has been plotted.

7.6.14. The results of the DMRB assessment are presented in the tables in **Appendix 7.3** along with the figures described above. The results are summarised in **Table 7-18** below. The following bullet points provide a summary for the key indicators supporting the assessment:

- No dwellings are predicted to experience a significant change in noise level and be exposed to noise levels above the relevant SOAEL in any scenario;
- The total number of dwellings exposed to noise levels above the SOAEL decreases in all scenarios (day and night) with the Scheme compared to the do-minimum year opening (DMOY);
- In the short term (day-time), four dwellings are predicted to experience a major increase in noise level (greater than 5 dB). Three are below the LOAEL, and one is between the LOAEL and SOAEL (see **Figure 7-5**);
- In the short term (night-time), two dwellings are predicted to experience a major increase in noise level (greater than 5 dB). The predicted absolute noise level at one property is equal to the LOAEL and only marginally exceeds the LOAEL (by less than 0.5 dB) at the other property. Assuming a reduction of 15 dB through a partially open window, night-time noise levels within bedrooms would be below the recommended internal noise limits for sleeping as set out in BS 8223 (Ref 7.20);
- In the long term, no receptors (dwellings or OSRs) are predicted to experience a major increase in noise levels. A moderate increase in noise level (3-5 dB) is shown at 45 dwellings during the day-time, 23 of which are between the LOAEL and SOAEL, the remaining 22 are below the LOAEL. During the night-time, 38 dwellings show a moderate increase in noise level, 36 of which are between the LOAEL and SOAEL. The remaining 2 are below the LOAEL (see **Figure 7-6**);
- In all scenarios, more dwellings are predicted to experience a minor, moderate or major beneficial (decrease) change in noise level than are predicted to experience an adverse (increase) change;
- No changes (either increase or decrease) greater than minor magnitude are predicted at OSRs in any scenario;
- 10 dwellings have been identified as having the potential to qualify under the Noise Insulation Regulations 1975 (as amended 1988) (see **Figure 7-6**); and
- The final significance has been determined based on guidance contained within DMRB LA111 including the absolute noise level in relation to the LOAEL and SOAEL, acoustic context and different magnitude of impact in the long term compared to the short term.

Table 7-18 - Road Traffic Noise (Operation)

Assessment Component	Commentary
Operational Road Traffic Noise	Dwellings In the short term day-time period, 97 dwellings would experience a minor increase in noise level (less than 3 dB). 28 dwellings would experience a moderate increase in noise levels (between 3-5 dB). Four dwellings would experience a major increase (more than 5 dB). 902 dwellings would experience a decrease in noise level, 250 of these would be a minor decrease and six would experience a moderate decrease.

	Of the four dwellings predicted to experience a major increase, three are below the LOAEL, and one is between the LOAEL and SOAEL. None are above the day-time SOAEL. For dwellings with a moderate increase in day-time noise levels, none are above the SOAEL. Seven are between the LOAEL and SOAEL with the remaining 21 subject to noise levels below the LOAEL. During the night-time (short term), 76 dwellings would experience a minor increase in noise levels, 21 dwellings would experience a moderate increase and two a major increase. 927 dwellings would experience a decrease in noise level, of which 226 would be minor and five would be moderate. The two dwellings with a major increase in night-time noise are exposed to absolute levels between the LOAEL and SOAEL. In the long term (day-time), 80 dwellings would experience a minor increase in noise level (less than 5 dB). 45 dwellings would experience a moderate increase in noise levels (between 5-10 dB). 1,068 dwellings would experience a decrease in noise level, 122 of which would be a minor decrease and 15 would experience a moderate decrease. For dwellings with a moderate increase in day-time noise level, 22 are below the LOAEL, the remaining 23 are between the LOAEL and SOAEL. During the night-time (long term), 59 dwellings would experience a minor increase in noise levels and 38 dwellings which would experience a moderate increase. 1,068 dwellings would experience a decrease in noise level, 70 of which would be a minor decrease and 10 a moderate decrease. For dwellings with a moderate increase in night-time noise levels, two are below the LOAEL and the remaining 36 are between the LOAEL and SOAEL. Other Noise Sensitive Receptors (OSRs) In the short term, the number of OSRs predicted to experience a minor increase in noise level is five during both the day-time and night-time periods. Nine OSRs would experience a minor decrease in noise level in the long-term during both the day and night periods. In the long term, negligible increases (less than 3 dB) are predicted at six OSRs in both the day and night periods. Two OSRs are subject to a minor decrease in noise levels in both the day and night periods. Seven show a negligible decrease. No changes (either increase or decrease) greater than minor are predicted in any scenario. The final significance has been determined based on guidance contained within DMRB LA111 and has considered the following: A small number of dwellings (three) within close proximity of the Scheme are predicted to experience a major change in the day-time noise level in the short term. In the long term, the predicted change is of moderate magnitude and therefore less than in the short term. The predicted absolute noise levels are below the LOAEL. Two dwellings within close proximity of the Scheme are predicted to experience a major change in the night-time noise level in the short term. In the long term, the predicted change is of moderate magnitude and therefore less than in the short term. The predicted absolute noise levels are equal to, or marginally above (less than 0.5 dB) the LOAEL.

	In all scenarios, more dwellings are predicted to experience a minor, moderate or major beneficial (decrease) change in noise level than are predicted to experience an adverse (increase) change. The number of dwellings within the study area exposed to noise level above the SOAEL during both the day and night time periods is reduced with the Scheme. A minor, or lower, magnitude of change in noise level is predicted at all OSRs. The sensitivity of dwellings is considered to be high, and the magnitude of change prior to mitigation, is considered to be moderate. Therefore, there is likely to be a direct, long-term minor adverse effect on dwellings (not significant) prior to the implementation of secondary mitigation measures. The sensitivity of OSRs is considered to be high, and the magnitude of change prior to mitigation, is considered to be minor. Therefore, there is likely to be a direct, long-term minor adverse effect on dwellings (not-significant) prior to the implementation of secondary mitigation measures.
Secondary Mitigation	No additional noise mitigation for operational road traffic noise is proposed.
Residual effects and monitoring	The sensitivity of dwellings is considered to be high, and the magnitude of change prior to mitigation, is considered to be moderate. Therefore, there is likely to be a direct, long-term minor adverse effect on dwellings (not significant). The sensitivity of OSRs is considered to be high, and the magnitude of change prior to mitigation, is considered to be minor. Therefore, there is likely to be a direct, long-term minor adverse effect on dwellings (not significant).

Substation Noise

7.6.15. The Scheme involves the relocation of a substation at the western end of the Scheme, close to the junction with the existing A29/Fontwell Avenue. Sound power data for the substation has been provided by Scottish and Southern Electricity Networks (SSEN). This indicates that the sound power is 61 dB at 100 Hz. The predicted noise level from the substation at the closest noise sensitive receptor to the relocated substation has been calculated and compared to the background sound level at night. The background sound level has been taken from data measured during the noise survey at a representative location, namely LT2 on Barnham Road (see **Table 7-19**).

Table 7-19 - Predicted noise levels from substation

Receptor	Predicted Noise Level from substation, dB L_{Aeq}	Rating Noise Level* from substation, dB $L_{A,r}$	Typical Background Sound Level, L_{A90} dB (23:00 – 07:00)	Comparison with Background Sound Level
Lyndhurst	15	18	23	-5

* 3 dB penalty applied due to potential for tonal element of noise at 100 Hz generated by substation in line with BS 4142 guidance

7.6.16. **Table 7-19** shows that the predicted Rating Level is below the existing background sound level at the closest noise sensitive receptor to the Scheme. It is noted that minor increases in road traffic noise levels as a result of the Scheme are predicted at this location. During the night-time, the background sound level (L_{A90}) is largely unaffected by noise from road traffic

and therefore the existing ambient background sound level is considered representative of the future baseline with the Scheme operational.

The results of the assessment of noise from the relocated substation summarised in **Table 7-20** below.

Table 7-20 - Noise from substation (Operation)

Assessment Component	Commentary
Noise from relocated substation	The predicted rating noise level from the relocated substation at the closest noise sensitive receptor (a dwelling) has been compared to the background sound level at night-time and is shown to be lower (Table 7-19). In line with guidance in BS 4142 (Ref 7.10) this is an indication of low impact, depending on context. The assessment has considered a worst-case scenario by comparing the noise from the substation to night-time background sound levels which are lower than those during the day-time. Therefore the predicted noise level is below the LOAEL set for fixed plant. The sensitivity of dwellings is considered to be high, and the magnitude of change prior to mitigation, is considered to be negligible Therefore, there is likely to be a direct, long-term negligible effect on dwellings (not significant) prior to the implementation of mitigation measures.
Secondary Mitigation	No further noise mitigation is proposed
Residual effects and monitoring	The sensitivity of dwellings is considered to be high, and the magnitude of change prior to mitigation, is considered to be negligible. Therefore, there is likely to be a direct, long-term negligible effect on dwellings (not significant).

7.7 LIMITATIONS AND ASSUMPTIONS

7.7.1. The assumptions and limitations which apply to this assessment are set out in detail within this chapter. These are summarised below:

- Information on construction activities and plant has been provided by a contractor appointed to provide reasonable assumptions on the likely works;
- The operational road traffic noise assessment has used traffic flows provided. The details of which, including any limitations and assumptions are contained within the Traffic Forecasting Report (see **Appendix 8.1**);
- The parameters used within the operational road traffic noise model are listed in Section 7.3, and
- Noise data for the relocated substation has been provided by SSEN.

7.8 CUMULATIVE EFFECTS

CONSTRUCTION

7.8.1. The study area for the construction assessment is:

- 300m: noise effects from construction activities, such as material movements, earthworks, ground improvement and piling, crushing and breaking; and

- 100m: ground-borne vibration effects from high energy construction activities, including compactors.

7.8.2. As set out in **Chapter 14: Cumulative Effects** (Table 14-1) committed developments with the potential for inter-project (in-combination) effects have been identified. Of these, four are located within the study area for the construction noise and vibration assessment.

7.8.3. **Table 7-21** presents the findings of the potential inter-project cumulative effects for each identified committed development for the construction phase.

Table 7-21 – Assessment of Inter-Project Construction Phase Noise and Vibration Effects

Committed Development	Distance	Assessment of Effect
Land at Former Eastergate Fruit Farm (4)	300m (west)	There is the potential for construction activities from this approved development may overlap with those associated with the Scheme, however timescales and activities for construction works are not known at this stage. The committed development is likely to result in construction noise and vibration as a result of construction activities and demolition. Due to the proximity of the committed development to the Scheme this is likely to result in an in-combination effect on nearby receptors, namely residential properties on Barnham Road (west of the Halo site). A **Moderate Adverse** effect as a result of construction noise and vibration from the Scheme has been identified. Assuming the developer implements similar mitigation measures to that of the Scheme, additional intra-project effects with this committed development on sensitive receptors is not anticipated.
Land West of Fontwell Avenue (16)	200m (north)	The construction programme for the Scheme (Chapter 3: Description of Scheme, Table 3-1) is 12 months. The committed development does not have planning permission currently, and timescales and activities for construction works are not known. Therefore it is not anticipated that construction works would overlap.
Arun District Strategic Housing Allocation (17)	Adjacent / within the site	The site relates to land allocated for housing development and forms part of a masterplan. Individual developments within the masterplan are being brought forward. Therefore, the potential for intra-project effects from the masterplan have been considered for individual developments where these fall

		within the study area identified above, namely the Barratts Development
Barratts Development "Adjacent Proposed Scheme" (19)	Adjacent / within the site	The construction programme for the Scheme (Chapter 3: Description of Scheme, Table 3-1) is 12 months. There is the potential for construction activities from this approved development may overlap with those associated with the Scheme, however timescales and activities for construction works are not known at this stage. The committed development is likely to result in construction noise and vibration as a result of construction activities and demolition. Due to the proximity of the committed development to the Scheme this is likely to result in an in-combination effect on nearby receptors, namely residential properties on Ewens Gardens and Murrell Gardens (east of the site). Once constructed, the noise barrier to the southern end of the Scheme has the potential to provide screening of construction activities taking place on the site of this committed development. A **Moderate Adverse** effect as a result of construction noise and vibration from the Scheme has been identified. Assuming the developer implements similar mitigation measures to that of the Scheme, additional intra-project effects with this committed development on sensitive receptors is not anticipated.
A description of the development is provided within Chapter 14: Cumulative Effects, Table 14-1		

7.8.4. A **Moderate Adverse** effect as a result of construction noise and vibration from the Scheme has been identified (see **Table 7-16** and **Table 7-17**). Based on the findings presented in **Table 7-21**, additional intra-project effects with the committed development on sensitive receptors is not anticipated.

OPERATIONAL

7.8.5. As set out in Section 7.3 above, the traffic data used in the assessment is inherently cumulative as it is based on future traffic growth. The Do-Something Future Year (DSFY) scenario assumes Phase 2 of the A29 Realignment has been constructed (in addition to other schemes as set out in **Chapter 14: Cumulative Effects**). Phase 2 of the A29 Realignment is located to the south of the Scheme from the junction with Barnham Road to re-join the existing A29 south of Westergate. Whilst noise generated by traffic on any new road which forms Phase 2 will be assessed as part of any future planning application, the changes in traffic flow on Phase 1 (i.e. the Scheme) and associated noise has been included in this assessment. This represents a worst-case scenario in terms of increased traffic flow and noise increase at properties within the study area for the Scheme.

7.8.6. Consequently, the operational impacts presented in Section 7.6, which are inherently cumulative, have been shown to be 'not significant' in relation to road traffic noise.

7.8.7. Furthermore, as identified in Section 7.5 above, the potential residential development with up to 500 dwellings, a care home and public open space on land adjacent to the Scheme between Eastergate Lane and Barnham Road (planning ref BN/122/19/EIS) (known as 'the Adjacent Proposed Development') has been considered within the assessment set out above. This has included the use of an absorptive material for the north section of the noise barrier (approximately 280 m) which faces the site of the potential new residential development. This is to reduce the potential for the reflection of noise from the noise mitigation barrier positioned on the eastern side of the Scheme to any new dwellings on the western side of the Scheme.

7.9 SUMMARY

7.9.1. **Table 7-22** provides a summary of the findings of the assessment.

Table 7-22 - Summary of Effects Table for Noise and Vibration

Description of Effects	Receptor	Significance and Nature of Effects Prior to Secondary Mitigation	Summary of Secondary Mitigation	Significance and Nature of Residual Effects
Construction Phase				
Noise	Residential dwellings	Major - / T / D / ST	Use of BPM, specifically: All vehicles and plant will be switched off when not in use; Design and use of site hoardings and screens, where necessary, to provide acoustic screening at the earliest practicable opportunity. Where practicable, gates will not be located opposite buildings containing NSRs; Vehicle and mechanical plant fitted with effective exhaust silencers; Positioning of construction plant and activities to minimise noise at sensitive locations; Equipment that breaks concrete by munching or similar, rather than by percussion, and The use of mufflers on pneumatic tools.	Moderate - / T / D / ST

Description of Effects	Receptor	Significance and Nature of Effects Prior to Secondary Mitigation	Summary of Secondary Mitigation	Significance and Nature of Residual Effects
Vibration	Residential dwellings	Major - / T / D / ST	Use of BPM, specifically: selection of low vibratory equipment and methodologies; contact details for nominated site contact for local residents to deal with complaints and engaging with local residents; and no start-up or shut down of vibratory plant e.g. rollers or compactors, within 50m of receptors.	Minor/Moderate - / T / D / ST
Operational Phase				
Road traffic noise	Dwellings	Minor - / P / D / LT	N/A	Minor - / P / D / LT
Road traffic noise	Other Sensitive Receptors	Minor - / P / D / LT	N/A	Minor - / P / D / LT
Noise from relocated substation	Dwellings	Negligible N/A / P / D / LT	N/A	Negligible N/A / P / D / LT

Key to table:

+ / - = Beneficial or Adverse P / T = Permanent or Temporary, D / I = Direct or Indirect, ST / MT / LT = Short Term, Medium Term or Long Term, N/A = Not Applicable

REFERENCES

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- Reference 7.2: Environmental Noise (England) Regulations 2006 (as amended).
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- Reference 7.20: BS 8233 (2014) Guidance on Sound Insulation and Noise Reduction for Buildings.

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